

## NOTES ON CALIFORNIA MAMMAL ECTO- PARASITES FROM THE SIERRA NEVADA FOOTHILLS OF MADERA COUNTY

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### INTRODUCTION

Data were recorded for 21 species of ectoparasites from 520 mammals captured at the San Joaquin Experimental Range and surrounding areas in the Sierra Nevada foothills of eastern Madera County during summer blood parasite surveys for '50, '51, and '52 by the junior author (Wood, 1952) and field surveys in '53 by the senior author. Additional specimens were obtained through the cooperation of Station Zoologists, Nathan W. Cohen (4 lots) and Henry E. Childs, Jr. (5 lots). All ectoparasites not collected at the Experimental Range are specified as to locality.

At least 520 mammals of 22 species were sampled including 340 rodents (12 species), 162 bats (5 species), 13 lagomorphs (2 species), 4 carnivores (2 species) and 1 insectivore. The number of each species examined is indicated in parentheses after the mammals common name. Unless indicated in the discussion of each ectoparasite, the number examined follows the species name.

### MATERIALS AND METHODS

Since many of the mammals were released in the field, or used for other purposes, only those ectoparasites actively crawling about were taken by combing and drowning in a drop of alcohol, or seized with forceps while the animals were confined to hardware cloth cylinders. In a few instances, specimens were obtained from dead mammals.

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All ectoparasites were preserved in 80% alcohol for temporary storage. Later the fleas, mites, lice and immature ticks were slide mounted, using the usual potash treatment before dehydrating. The senior author prefers a 10% aqueous solution of sodium hydroxide for the potash agent. The ectoparasites were removed from the 80% alcohol, washed in tap water one hour, and placed in the NaOH overnight. In the morning they were washed for two hours in tap water, again placed in 80% alcohol, and dehydrated by transferring through 90%, 95% and absolute alcohol, allowing one hour for each solution. The clearing media used was methyl salicylate, leaving the specimens for 12 hours. Creosote-balsam is the most practical permanent mounting media. Most slides were retained by the senior author, with reference specimens sent to the junior author and the zoological laboratory at the San Joaquin Experimental Range.

### ECTOPARASITE SURVEY

HOST: *Myotis yumanensis sociabilis* H. W. Grinnell, Yuma Bat (6).

*Myodopsylloides palposus* (Roths.), 1 ♀. This record should be noted as a stray since this flea is more commonly associated with larger bats than *Myotis*.

*Myodopsylla gentilis* Jord. & Roths., 10 ♀♀, 4 ♂♂. This flea has a distribution equal to that of its preferred host, *Myotis*. As with other insects of wide distribution, variations occur in important taxonomic features of this flea, particularly in the "finger", a component of the male genitalia. This structure varies from a rounded to a decidedly pointed apex. More constant characters of the male genitalia are the parameres (of authors) and sternite IX. Very few ectoparasites are so well adapted to existence upon a host animal as are fleas. They are laterally compressed with many posteriorly directed bristles which enable them to move with great rapidity through the host's fur. On a live host they are very difficult to capture. It is best to anesthetize the host and ectoparasites together with chloroform whenever possible.

*Cimex pilosellus* (Horvath), 1 ♂, (taken at Northfork).  
HOST: *Eptesicus fuscus bernardinus* Rhoads, Big Brown Bat (11).

*Spinturnix americanus* Banks, 2 ♀♀ (taken at Northfork).  
HOST: *Antrozous pallidus pacificus* Merriam, Pacific Pallid Bat (142).

*Ornithodoros stageri* Cooley and Kohls, 111 larvae. Since this tick is usually engorged when found on the host, it is larger than most other ectoparasites of *Antrozous* and may be conspicuous. However, many more immature specimens can be found by blowing the fur. Fifty-four were taken from 103 bats during July and August of '51. The largest number taken from one male bat was 5.

*Spinturnix americanus* Banks, 20 ♀♀, 31 ♂♂, 19 nymphs. This mite is very common on *Antrozous* as well as numerous other bats, being found crawling about or hiding on the under surface of the wing membranes. In 1951, thirty-one were removed from 42 bats. One male bat carefully searched revealed 21 specimens on the wing membranes. Many mites were noted on these bats during handling of specimens in August 1952. They are very hard to spot on the wing surfaces because of their protective coloration and habit of "freezing" while the bat is being handled.

*Mydopsylloides palposus* (Roths.), 1 ♀, 3 ♂♂. As Dr. Holland of Ottawa correctly indicated in his excellent monograph (1949) on the Siphonaptera of Canada, this flea should be assigned to the species *M. palposus* instead of *M. piercei* erected by the senior author (1941) when he originally described the genus. Records here add to our knowledge of the distribution of this ectoparasite. It is apparently restricted to the extreme Western North America, with many more records from western Canada than the western United States. Of the numerous ectoparasites taken from *Antrozous*, this flea species was encountered in the least numbers.

*Basilisa antrozoi* (Townsend) Nycteribiid Fly. During handling of 103 *Antrozous* in '51 and 101 new captures and repeats in '52, 114 tick flies were removed in '51 and 31 in '52. These ectoparasitic insects were very short-lived away from their hosts. Nine adults, 4 males and 5 females, isolated in a plastic box at 11 A.M. on August 27, 1952 were dead at 9:30 A.M. on August 28th.

These are very active wingless flies which scoot rapidly over the bat disappearing under the fur. They rarely venture from the host or out on the less haired wing membranes. Their clinging powers are remarkable for even when grasped with forceps they are pulled free of the clutched hairs with difficulty. At cooler air temperatures, they can be collected easily.

*Cimex pilosellus* (Horvath), Bat Bedbug. All bedbugs taken from the body of *Antrozous* have been adults. No nymphs have been seen on bats captured with nets at night. During July and

August of '50, 19 adults were captured from 78 banded bats. In July and August of '51, 34 males and 17 females were captured from 103 new and repeat bats handled. In August of '52, 4 males and 4 females were taken from 67 bats. Several hundred bedbugs of all instars were collected from 34 bats taken by Henry E. Childs, Jr. from the boarded up transom over doors at the abandoned grammar school at Knowles.

All adult bedbugs taken from the bats in the early evening hours at the Experimental Range were found on the radius where they hang on very tightly, pulling the skin with them when plucked off with forceps. Usually one or two adult bugs were removed from one bat, the largest number removed from one bat was 7.

During August of '50 a colony of 52 bats was removed from the headquarters office building. Their roost was a narrow space between roofing and adobe bricks where they had body contact with under roof and adobe brick surfaces. While removing the bats from this very hot area, many nymphal and adult bedbugs were seen scurrying for cracks in the roofing or between joists and adobe bricks.

HOST: *Procyon lotor psora* Gray, Raccoon (3).

*Echidnophaga gallinacea* (West.), 2 ♀♀. This is the stick-tight flea of chickens and is very common on ground squirrels. It is frequently found on predators of these animals. Due to their smaller size and lack of attachment, males are less easily collected than females. Once on a host, females remain with their mandibles embedded and attached to the host's skin. Gravid females often form clusters in preferred skin areas, and are thus readily observed.

*Pulex irritans* Linn., 7 ♀♀, Human Flea. In the early history of California this flea was a very serious pest of man. In more recent times it has become restricted here to native foxes, coyotes, bobcats and other small predators. The large size, and dark color of this flea makes it an easy specimen to capture even on living hosts.

*Ctenocephalides felis* (Bouche), 1 ♀. The capture of a single cat flea would seem to suggest it as a stray as recorded here. Apparently, however, this insect has successfully adapted itself to native as well as domestic hosts. Herman and Jankiewicz (1943) previously recorded this flea from the Audubon Cottontail. HOST: *Lynx rufus californicus* Mearns, California Wildcat (1).

*Echidnophaga gallinacea* (West.) 8 ♀♀, 1 ♂.

*Pulex irritans* Linn., 1 ♀.

HOST: *Homo sapiens sapiens* Linnaeus, Caucasian.

*Triatoma protracta* (Uhler), Western Conenose. This bug not only feeds on the wood rat but also enters homes and feeds on man. In '41 from homes, Lowell Adams forwarded 8 (5 ♂♂, 3 ♀♀) bugs of which 5 were infected. In '49, Lisle Green and Kenneth Wagnon sent 17 (12 ♂♂, 5 ♀♀) bugs for examination and 12 were infected with trypanosomes.

Intensive study of the area by the junior author was made possible during 12 weeks each in the summers of '50 and '51, and 6 weeks in '52. In '50, 56 (22 ♂♂, 34 ♀♀) bugs were obtained from homes and 5 others reported destroyed, the bulk (44) being taken in one dwelling whose occupants served as food for at least 2 bugs (Wood, 1951). Fifty-five of these bugs were examined for trypanosomes and 25 were found infected. In '51 and '52, 18 (12 ♂♂, 6 ♀♀) bugs were examined from homes with 5 of 9 infected in '51 and 6 of 9 infected in '52. One 5th nymph from the horse barn was negative in '52. Thus, of 104 bugs taken from homes, 98 were examined and 53 were found naturally infected with *Trypanosoma cruzi* Chagas.

The western conenose has been taken from beds and observed to crawl across the ceiling and drop to the bed below. At a ranch on Hildreth Road, *Triatoma* was observed to fly from a corner of the room to a seated person's lap. Common names used here for this bug were bedbug, kissing bug and mountain chint bug (Hildreth Road).

Most people do not react to the salivary secretions of *Triatoma*. Of the 40 persons known to be exposed to feedings of this bug, only 3 (1 ♂, 2 ♀♀) reported severe symptoms. Bite reactions included: rapid swelling at site of bite producing distinct welts; itching of palms of hands and soles of feet; general edema; erythema; swelling of eyelids, face and tongue; feeling of strangulation; dizziness; and a "sick to my stomach" feeling. Symptoms subsided usually in one week.

*Anopheles pseudopunctipennis franciscanus* McCracken. Search of many water areas revealed only 4 larvae from cattle water troughs during the summer of '51.

*Culex tarsalis* Coquillet. This is the common pest mosquito which drives man indoors during the early evening. Fifty-one adults were captured in '51 from groups of individuals congregating on the adobe brick corridor walls of the Superintendent's living quarters especially near ceilings where it is dark and windless. Larvae were found in great abundance in many cattle troughs over the Range.

HOST: *Citellus beecheyi fisheri* (Merriam), Fisher Ground Squirrel (3).

*Hoplopsyllus anomalus* (Baker), 34 ♀ ♀, 16 ♂ ♂. This flea, and the one listed below, is native to ground squirrels throughout the Pacific Southwest. It is not collected as readily on the host animal in Southern California as it is in their burrows. There, in the spring, it can be collected in great numbers by placing cotton rolled on a stick into ground squirrel burrows. After chloroforming, they can be shaken onto a white sheet of paper and preserved. As records here indicate, the reverse is true in the central part of the state. Linsdale (1946) found this flea most numerous in July, August and September at the Hastings Natural History Reservation. They were more numerous than *Diamanus* on the bodies of squirrels during these months. Very few were noted in burrows.

*Diamanus montanus* (Baker), 4 ♀ ♀, 4 ♂ ♂. In contrast to *Hoplopsyllus*, this flea is commonly collected from the body of ground squirrels, rather than its burrow. In some areas of California, various species of *Thrassis* are equally numerous on ground squirrels. As recorded by Augustson (1942), *D. montanus* does not feed readily on man, so is not as important in the dissemination of plague as is *Xenopsylla*. However, as with *Thrassis*, it is important in sylvatic plague surveys in the transmission of the disease from one animal to another. Linsdale (1946) found *Diamanus* most numerous on ground squirrels every month excepting July, August and September when outnumbered by *Hoplopsyllus*.

*Echidnophaga gallinacea* (West.), 26 ♀ ♀, 3 ♂ ♂.  
HOST: *Eutamias merriami merriami* (Allen), Merriam Chipmunk (8).

*Malaraeus telchinum* (Roths.), 1 ♀. This is probably a stray flea that is associated more commonly here with *Peromyscus* found in the same vicinity. All host specimens were immediately placed in cloth bags when collected, and later examined carefully. As these animals are not very active in the early spring (March), apparently their normal flea parasite, *Monopsyllus* sp., is also late in appearing in abundance.  
HOST: *Peromyscus maniculatus gambelii* (Baird), Deer Mouse (85).

*Malaraeus telchinum* (Roths.), 3 ♀ ♀, 2 ♂ ♂.  
HOST: *Peromyscus boylii boylii* (Baird), Brush Mouse (48).

*Malaraeus telchinum* (Roths.), 1 ♀  
HOST: *Peromyscus truei gilberti* (Allen), Rock Mouse (50).

*Malaraeus telchinum* (Roths.), 5 ♀ ♀, 3 ♂ ♂.  
HOST: *Microtus californicus mariposae* (Peale), California Meadow Mouse (76).

*Atyphloceras multidentatus* (Fox), 2 ♀ ♀.

*Malaraeus telchinum* (Roths.), 22 ♀ ♀, 10 ♂ ♂.

Host: *Neotoma fuscipes streatorum* Merriam, Dusky-footed Wood Rat (12).

*Ixodes angustus* Neum., 4 nymphs. This is a small tick found on a variety of mammals of wide distribution in the United States and Canada. Variants of this species are common, depending on locality and host, which has led to some confusion in its identity. Most misleading is the size and position of the anterior spur on Article I of the palpi. Viewing from above, this spur may be conspicuous or reduced entirely. As this is one important taxonomic characteristic in the identification of nymphs of the smaller species of the genus *Ixodes*, it is often necessary to slide mount specimens. In 1939 the senior author collected this tick (2 nymphs) from a ring-tail cat, *Bassariscus*, in Madera County south of Yosemite National Park.

*Orchopeas sexdentatus nevadensis* (Jord.), 9 ♀ ♀, 2 ♂ ♂. This species and its subspecies is a common, small flea appearing on many different native mice and rats of North America, with the western portion again represented better than elsewhere. Records here extend the western range of this subspecies into California farther than was previously known. Linsdale and Tevis (1951) reported 25 *O. sexdentatus* (no subspecies designated) from one rat, with an average of 3.8 per rat.

*Hoplopsyllus anomalus* (Baker), 1 ♀.

*Echidnophaga gallinacea* (West.), 1 ♀.

*Triatoma protracta* (Uhler), Western Conenose. This Reduviid bug is a known carrier of *Trypanosoma cruzi* Chagas and occurs naturally in houses of the wood rat but has been taken from occupied human dwellings as noted above. Wood rat houses are scattered over the Range with above ground stickpiles neither large nor conspicuous as in more heavily covered chaparral areas. During the summer of 1950 from 6 wood rat houses searched, 12 negative bugs (2 ♀ ♀, 2 ♂ ♂, 3-5th, 4-4th, 1-3rd nymphs) were obtained from 3 houses while 1 negative 5th nymph was found on the under surface of a large wooden box overlying a wood rat's grass nest. In 1952 with the aid of Henry E. Childs, Jr., two large woodpiles were searched for *Triatoma* since there appeared to be at least 3 different areas occupied by wood rats. From these three areas, 69 bugs (2 ♂ ♂, 8 ♀ ♀, 9-5th, 24-4th, 17-3rd, 9-2nd nymphs) were collected and 68 examined with 1-5th nymph revealing *Trypanosoma cruzi*. One wood rat house found in an abandoned ranch home, 3 miles southeast of Knowles, yielded 1 negative first instar nymph and 1 ♀ naturally infected with *T. cruzi*. Of 9 bugs from a wood rat house north of the headquarters

area forwarded by Henry E. Childs, Jr., January 15, 1953, 7 (1 ♂, 4 ♀♀, 2-5th nymphs) were naturally infected. One male was negative and one desiccated female was not examined.

*Triatoma* evidently uses down canyon swale air flow in this area since both adults collected in the early evening outside human dwellings were flying in this direction.

HOST: *Reithrodontomys megalotis longicaudus* (Baird), Western Harvest Mouse (2).

*Malaraeus telchinum* (Roths.), 7 ♀♀, 3 ♂♂. This is a very common flea found on a number of small mammals, particularly native mice, of Western United States and Canada. In the southern portion of California, and south into Mexico, this species is replaced by the closely associated species *M. sinomus* (Jord.). Both are small fleas, and are difficult to see and capture on live hosts.

*Atyphloceras multidentatus* (Fox), 1 ♀. Members of this genus are distributed in greater numbers on wood rats (*Neotoma*) than the mouse host recorded here. Stray fleas are often collected on mice associated with wood rats, particularly the parasitic mouse, *Peromyscus californicus insignis*. The spotted skunk (*Spilogale*) is occasionally a favored host of this flea. The number of western species of *Atyphloceras* greatly outnumbers those of the eastern United States.

HOST: *Sylvilagus auduboni vallicola* (Nelson), Audubon Cottontail (11).

*Odontopsyllus dentatus* (Baker), 8 ♀♀, 15 ♂♂. This large dark flea commonly infests western rabbits. In spite of its common occurrence, this is the first known record from Madera County. It is a very active flea and will quickly abandon a dead host, which may account for its scarcity in collections.

*Cediopsylla inaequalis interrupta* Jordan, 4 ♂♂. This is another common rabbit flea not as large and active as *O. dentatus*, and like the latter species recorded for the first time from Madera County.

*Hoplopsyllus anomalus* (Baker), 1 ♂. This record is an accidental occurrence on this host animal from closely associated ground squirrels.

*Anomiopsyllus nudatus* (Baker), 1 ♀. This very small flea is also of accidental occurrence on rabbits. The normal host animal is the wood rat, and the flea is more often collected from the grass nest of the wood rat than on the individual. This is the first known record of this species from Madera County.



## DISCUSSION

The following identifications were reported from additional ectoparasites forwarded to Dr. E. W. Jameson, Jr., at the University of California at Davis. Dr. James M. Brennan identified *Trombicula californica* Ewing and Dr. R. W. Strandtman identified *Haemolaelaps geomys* Str. from *Thomomys bottae mewa*. Dr. E. W. Jameson, Jr., identified *Trichodectes* and *Hirstionyssus* from *Thomomys bottae mewa* and *Hoploplura acanthopus* Burm. from *Microtus californicus mariposae*.

There were 228 fleas, 197 conenose bugs, 145 nycteribiid flies, 115 ticks, 79 bat bedbugs and 53 mites recovered from the 520 mammals examined. The total number of ectoparasites is small for the number of animals handled. This is due in part to the methods of capture used from live hosts. From 447 animals, 228 fleas were collected, or approximately 0.5 fleas per host. This compares favorably with other small mammal surveys in which snap traps were used although a modified Sherman live trap was used here for most forms. Undoubtedly ectoparasites were missed. Conspicuously absent are unengorged ixodiid larval ticks which are more difficult to observe on living hosts.

## SUMMARY

Eight hundred and seventeen ectoparasites are recorded from 520 mammal hosts including man. Additional annoyance of *Triatoma protracta* and *Culex tarsalis* to man is reported. Extensions of range are recorded for *Orchopeas sexdentatus nevadensis*, *Odontopsyllus dentatus*, *Cediopsylla inaequalis interrupta*, *Anomiopsyllus nudatus*, and *Myodopsylloides palposus*.

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